

## REVIEW

**Flora of China, vols. 2–3, Lycopodiaceae through Polypodiaceae**, by Wu Zhengyi† and Peter H. Raven, Co-chairs of the Editorial Committee and Hong Deyuan, Vice Co-chair of the Editorial Committee. Science Press (Beijing) and Missouri Botanical Garden Press (St. Louis). ISBN 978-0-915279-34-0 (series), ISBN 978-1-935641-11-7 (vols. 2–3). Publication date: 6 June 2013.

959 pages; English, with Chinese authors' names and Chinese common names in both roman and Pinyin, and roman and Pinyin indices of Chinese common names (no common names are given in English).

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The final text volume of the great new Flora of China, published as a cooperative venture by a consortium of Chinese botanists and international experts, has arrived. Inspired by Peter Raven, it was originally proposed at a joint meeting of Chinese and American botanists held at the University of California, Berkeley, in 1979. It was formally initiated in 1988 with the appointment of a joint Sino-American Editorial Committee, with Raven and Wu as Co-chairs. Further details of its inception are given in the Foreword to the first published volume, 17: vii–viii, 1994. It is a testament to the foresight of Raven and Wu (who passed away in June 2013), and a proud achievement for China and the world botanical community. Planned as an updated and revised English language edition of the *Flora Reipublicae Popularis Sinicae* (FRPS, 1959–2004), it is remarkable that this Flora – now 24 volumes bound in 21 books and awaiting only the introductory volume – has been brought to fruition in such a short time. Just coordinating the contributions from 59 authors for the current volume (26 Chinese authors and 33 others) must have been a difficult task. The work was undertaken at eleven botanical institutions, four in China and seven elsewhere, with overall organization and coordination at the Missouri Botanical Garden. Details may be seen at the Project website, [flora.huh.harvard.edu/china](http://flora.huh.harvard.edu/china). Throughout the entire Flora, the Editorial Committee has been under the unbroken and steady leadership of both Raven and Wu. The undertaking was massive, its execution nearly flawless. This combined volume is dedicated to the Chinese pteridologist Ching Ren-Chang (1898–1986), who was Secretary General of the FRPS project.

For pteridologists, last is best, given the substantial progress made in our understanding of the phylogenetic relationships of ferns and lycophytes since the project began, not to mention the additional floristic knowledge and discoveries. We commend the editors and authors, and recommend the book to anyone seriously interested in Chinese botany or ferns.

China is enviably wealthy in pteridophytes, particularly ferns, and this wealth is arrayed for study by anyone who takes up this book. As stated in the preface, “[The pteridophyte flora of China] includes 38 families, 177 genera, and 2,129 species, among which three genera and 842 species are endemic to China, and one genus and four species are introduced to China.” This is eye opening for North American fern lovers: we have only 96 genera and 554 species (FNA 1993). Various historical events, especially the Himalayan orogeny and the recent glaciations of North America, have set the two areas on different paths, and China is the richer by far. One has only to contemplate its 123 species of *Athyrium* vs. our two species, its 167 species of *Dryopteris* to our fourteen, or its 207 species of *Polystichum* to our fifteen (we share four), to wonder how different things could have been. Our two regions share approximately 60 indigenous species but for the most part, these do not occur in the classic East Asia – Eastern North America pattern so well known in angiosperms. Instead, most of our shared species are circum-north temperate or circumboreal, e.g., several lycopods, eight horsetails, and such species as *Cryptogramma stelleri*, *Woodsia ilvensis*, *W. glabella*, *Gymnocarpium jessoense*, and *Dryopteris fragrans*.

The volume has only short prefatory remarks, without discussions of geography, climate, or floristic associations. The heading of the main text is labeled “Pteridophytes (Lycophytes and Ferns)” which, for ferns, transitions away from the recently popular “monilophytes.” Families are presented in taxonomic order, based on the linear classification of Christenhusz et al. (2011), itself based largely upon Smith et al., (2006). Following Christenhusz et al., Equisetaceae are treated first (vs. Ophioglossaceae in the scheme of Smith et al. 2006), as sister to the rest of the ferns.

Treatments are in standard format and include dichotomous keys and full descriptions of families, genera, and species. Subspecies, varieties and, in a very few instances, forms are treated where authors deem necessary. Hybrids are mentioned, at least in some genera, but are not treated in depth. Keys and descriptions show the high standards that one anticipates from previous volumes. The descriptions are extremely detailed, most involving 75–100 morphological characters and often running from 25 to 35 or even 40 lines, although the treatments of Hymenophyllaceae are notably shorter. Short or full synonymies are given, but types are not reported. Each species description is followed by a statement of habitat, a list of provinces (including Taiwan and islands of the South China Sea) where it occurs, and a statement of worldwide range. Following that are notes about relationships, variability, medicinal uses (if any), and nomenclatural problems. These notes offer insight into historical and current taxonomic concepts, problems in the flora, and often additional comparative details of identification. They will be of great interest to current and future pteridologists as our knowledge improves and will no doubt prompt studies for many years to come.

Inevitably, some families (e.g., Ophioglossaceae) lack recent research focused on China, while others (e.g., Aspleniaceae) benefit from recent and ongoing scrutiny, so the treatments are slightly uneven by subject, but they

consistently include the best research available. More thoroughly than many floristic treatments, attention is paid to enumerating (if not explicating) taxa about which little is known, or for which types or other supporting specimens have not been seen. Thus, many genera are followed by lists of “uncertain taxa.” Such careful explication of the lack of knowledge can be very helpful and is much better for future users than simply glossing over such gaps.

There will always be areas of taxonomic disagreement, and such disagreements can make for good discussions. Fortunately in most cases, justification of the author’s choices is given, either directly or by reference to literature. Notably, all references are given in text rather than in a separate section. We think the following taxonomic decisions may enliven the discourse:

- The recognition of various generic segregates and species assignments in Lycopodiaceae, especially the recalcitrant *Lycopodium sensu medio*, in which North American plants are now rather standardly treated in several segregate genera i.e. *Palinhaea*, *Diphasiastrum*, *Dendrolycopodium* (not mentioned in synonymy), and *Spinulum*.
- The inclusion of *Pseudolycopodiella* in *Lycopodiella*. We suspect that debate over generic limits in Lycopodiaceae will continue for the foreseeable future.
- The presence of *Huperzia appressa* (type from Newfoundland) and *H. lucidula* (type from eastern North America) in China. *Huperzia appressa* in particular has not frequently been recognized outside North America.
- That *Adiantum aleuticum* is subsumed into *A. pedatum* (type from eastern North America). This disposition neglects evidence that the two taxa are reproductively isolated (Paris 1998). Perhaps the *Adiantum* authors’ decision was based on the results of Lu et al. (2012) who, using chloroplast markers, showed that *A. aleuticum* is nested within *A. pedatum*. Even so, Lu et al. (2012) concluded that “Chinese *A. pedatum*, the Japanese *A. pedatum* ... and the eastern North American *A. pedatum* are not the same taxon.”
- The recognition of *Cystopteris dickieana* in China, albeit with the caveat that Scottish (i.e., typical) and North American plants “are considered conspecific with *C. fragilis*.” The authors’ phrase, “the taxonomic status of Chinese *dickieana* (i.e., plants with rugose or verrucose perispores) is uncertain” serves to highlight that this is still an unresolved problem. Perhaps the Chinese plants should not have been given species status at this juncture. No doubt cryptic species are hiding in *C. fragilis* in China, as elsewhere.
- Placement of the contentious genus *Cystoathyrium* in Cystopteridaceae. *Cystoathyrium* comprises a single, rare, and perhaps extirpated species endemic to forested areas in western Sichuan. Authors Zhongren and Kato include it in Cystopteridaceae with text contrasting it to both *Cystopteris* and *Athyrium*. We agree because, although homoplastic within Eupolypods II, the character states exhibited by *Cystoathyrium* occur more frequently in Cystopteridaceae than in Athyriaceae.

- The treatment of both *Asplenium dolomiticum* and *A. quadrivalens* as species within the *A. trichomanes* complex. Historically, this complex has been important in fern systematics in terms of shifting botanical science from descriptions to explanations, and so it continues to provide food for thought.
- *Asplenium komarovii* is the name used for tetraploid plants of *A. scolopendrium*. Whether or not this is equivalent to the North American tetraploid *A. scolopendrium* var. *americanum*, listed as threatened under the federal Endangered Species Act, will be of interest.
- The adoption of many new generic concepts in Polypodiaceae among both grammitids and polypods. We expect this to facilitate recognition of taxa since the new groups are morphologically more cohesive than previous classifications. These concepts match those used in the recently published Flora of Peninsular Malaysia, Series I: Ferns and Lycophytes, Volumes one and two (Parris et al., 2010, 2013), itself a valuable supplement to the current volumes for more tropical elements of the Chinese flora. The generic concepts are also matched for the most part by Zhang's (2012) recent photographic guide to ferns of China, although Zhang retained *Oreogrammitis* and *Radiogrammitis* in *Grammitis*.
- The sinking of *Dryopteris* subgenus *Nothoperanema*, *Dryopteris* subgenus *Erythrovariae* and *Dryopteris* section *Dryopsis* into *Dryopteris*, a decision that places *Acrophorus*, *Diacalpe*, *Dryopsis*, *Nothoperanema*, and *Peranema* into synonymy. Evidence for this dates back to the phylogenies presented by Geiger and Ranker (2005), Li and Lu (2006), and Liu et al. (2007), but combinations (Zhang and Zhang, 2013; Zhang et al. 2013 a) were not made until publication of the comprehensive study by Zhang et al. (2013c).

More than 150 taxonomic innovations are presented and seven new species (in *Lycopodium*, *Asplenium*, *Polystichum*, *Radiogrammitis*, and *Oreogrammitis*) and two new nothospecies (in *Asplenium*) are described. Most of the others are transfers including 41 to *Deparia* (many previously in *Dryathyrium*), 32 to *Selliguea* (mostly previous *Phymatopteris*), and 23 to *Diplazium*. Besides those in normal sequence, a few new combinations are buried in text and could be easily overlooked, e.g., *Hymenasplenium rivulare* (Fraser-Jenkins) Viane & S. Y. Dong, made in the discussion of the genus, and *H. ikenoi* (Makino) Viane, made under the discussion of *H. cardiophyllum*. Fortunately, a complete list of novelties is presented in the back to aid indexers.

A feature of this combined volume is a glossary specific to the subject matter, in this instance adapted from Lellinger (2002). (A similar glossary is also included in vol. 22, Poaceae. Unfortunately, at least two errors are here, there being no definition of "scale" (implied to be present by reference under "costate") and no definition of "pteridophytes" (implied to be present by reference under "ferns"). One might also quibble that use of the word "gemma" for the bulbils of some *Huperzia* is not attributed to North American literature, e.g., FNA (1993) as well as European and African literature. Nor is "gemma," as defined in the glossary ("a structurally specialized asexual propagule found on some gametophytes...") mentioned in the treatments of Hymenophyllaceae, where it would be expected.

Some of the text, perhaps inevitably, leaves the glossary aside so that there is occasional use of non-standard terminology. For example, *Ceratopteris* is described as “juicy,” *Diplaziopsis* as having “semi-circular” spores, Rhachidosoraceae as having “2-sided spores with flakelike folds in the perispore” and *Cystoathyrium* as having a stipe base that is not “beak-shaped.” “Bract,” not defined in the glossary, is used to mean a microphyll on the peduncle in *Lycopodium* and *Lycopodiella* but in Glecheniaceae refers to the bud-covering structures elsewhere called “pseudostipules” (Shaw and Ranker 2011).

Typographic errors are virtually or actually nonexistent, as we have found none to date. The misspelling of *Parathelypteris noveboracensis* as *novoboracensis* (p. 327, in discussion of *Parathelypteris nipponica*) is repeated in the index so it is not merely a typo. We noted only a very few factual errors on first study: *Lycopodiastrum* is described as a woody vine when in fact all lycophytes are non-woody plants, merely stiff and lignified. North America is not included in the range of *Parathelypteris*. The term acrostichoid appears in the glossary, but is not employed in descriptions where it should be in *Dryopteris* subgenus *Elaphoglossoideae*, while in *Bolbitis*, where it is applied, the sori are superfluously described as exindusiate (superfluous because this is implied in the definition of acrostichoid). *Bolbitis* is further said to have spores with a thick epispore, a term normally applied to spores of *Equisetum* and the heterosporous water ferns; perhaps perispore was intended. Finally, the term homomorphic, as used in the key to the Tectariaceae, is misapplied and should be replaced with monomorphic.

The Flora of China will be hard to surpass in this century, at least in a book format. Field guides and local floristic efforts – many of which will be web-based – may be more colorful and may present much additional information, but this volume will stand for many years as the authoritative resource on the lycophytes and ferns of China. Even more, its publication will inform and enliven pteridophyte research throughout Asia, as participants affirmed at the 2013 Flora Malesiana conference in Bogor, Indonesia, even as they anticipated taxonomic attention shifting deeper into the tropics. Moreover, it will shift the focus from taxonomic to evolutionary questions: speciation, breeding systems, and reticulate evolution remain largely unexplored in the region. We very much look forward to the introductory volume for perspectives on ecology, and to the soon forthcoming companion volume(s) of illustrations.

In 2006, one of us (MS) had the fortune to accompany Flora authors David Barrington, He Hai, and LiBing Zhang on a collecting trip through Sichuan and Yunnan Provinces focused on resolving issues in Dryopteridaceae. Browsing the completed treatments brings back the thrill of botanizing Mt. Omei and Yulong, and the daunting complexity of Chinese *Polystichum*. Having the full flora in hand now leaves us eager to dig deeper into the ferns and lycophytes of this fascinating region.—ARTHUR V. GILMAN, Gilman & Briggs Environmental, 1 Conti Circle, Suite 5, Barre, Vt 05641; MICHAEL A. SUNDUE, The Pringle Herbarium, Dept. of Plant Biology, Torrey Hall, 27 Colchester Ave., University of Vermont, 05405, U.S.A.

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